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Observing The Impact of Communication and Information Technology on "Net-Work"*

The Evolution of Telework

Telecommuting (also called telework[1]) has cycled in and out of public consciousness for about 30 years. It first emerged as a major topic for organizational designers and social activists during the 1970s when the both the gas shortage crisis and the environmental movement sparked an interest in finding alternatives to the energy consumption, traffic problems and pollution caused by everyday commuting in the United States. Thus most early research was dominated by the metaphor of "conservation" and focused on the transportation-technology trade-off (e.g., Niles et al. 1976). Telework research of this period peaked in the 1980s. The next wave of studies focused on the time that people were saving because they worked at home — time lost to commuting, interruptions, not having to attend unnecessary meetings. This "productivity" era of research reported that telecommuters were more efficient, effective, and in other words, productive (e.g., Olson 1988a; Gordon 1988) although they sometimes suffered from isolation (Costello 1988). Telework adoption, however, progressed far less quickly in the 1980s than originally predicted, primarily because of managerial resistance to off-site employees, which has been uncovered as a primary barrier to telework's adoption (e.g., Olson 1988b).

In the United States, interest in telecommuting was renewed in the 1990s specifically because of two natural disasters. Los Angeles became a testing ground for telecommuting in the wake of the Northridge earthquake of 1994.[2] And along the East Coast, the great blizzard of 1996 caused many businesses to shut down, which generated an interest in finding ways to free work from the devastating effects of the weather. At this same time, a survey by Telecommute America (an Arizona-based consortium), found that the volume of email did not significantly change during the blizzard. This was interpreted by many, including AT&T's telecommuting expert, Susan Sears, to mean that there had been no real loss in productivity during the blizzard despite workers' inability to be at their work sites. The survey also reported that, perhaps as a result of such endorsements of virtual work, 10% of all Fortune 1000 companies were to begin pilot

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telecommuting programs during 1996. These pilot programs were enabled by the increasing sophistication of information and communication technologies in the 1990s, specifically, the growth in popularity of technologies like the cell phone, PDAs (personal digital assistants), teleconferencing, email, the Internet, and smaller, lighter laptops. This "technology" based decade has brought a paradigmatic change in telecommuting configurations and philosophy.

The continued evolution of business models and organizational structures, especially due to the changes brought about by globalization, have also resulted in greater adoption of telecommuting. The number of companies offering telecommuting has risen since the mid-90s, from 19.5% in 1996 to 28% in 1999.[3] A report released by the Washington D.C.-based Employment Policy Foundation [4] projects that within the next five years, up to 25% of the U.S. workforce might be telecommuting.

Despite growing interest, it is difficult to accurately determine the levels of telecommuting adoption because there is such a wide array of work practices that fall under this rubric. While there is a lack of definitional consensus, it is obvious that telecommuting is finally gaining the legitimacy that was predicted 30 years ago and growing very rapidly. Testimony earlier this year claimed that the number of teleworkers climbed from 8.5 million in 1995 to 19.6 million near the end of 1999 and a predicted 137 million world-wide by 2003.[5]

The rapid growth of the Internet and the emergence of a multitude of tools for remote access are likely the key enablers of this significant expansion. One of the changes observed is that increasingly, employees who might work full time in a central office also routinely do "work" at home. Office automation has transformed many paper-based procedures into electronic ones, and face-to-face communication has been reduced by the advent of technologies such as voicemail, teleconferencing and email. These changes, in addition to the availability of high-speed connections, allow people to check email and voicemail from home, and to access the Internet for work-related research.

It is unclear the degree to which casual telecommuting is being accurately measured although it is clear that it is becoming much more common. Ray Boggs, director of Home Office research at International Data Corp. makes a distinction between "formal" and "informal" telecommuters claiming, "most of the telecommuters are informal and that's what's going to grow tremendously."[6] Boggs also sees informal telecommuting as an employee retention tool in a tight labor market.

According to Mary Slepicka (1999), finding and keeping workers is perhaps the number one issue facing telecommunications and other hi-tech companies today.[7] The economy is strong, with unemployment rates at a steady 4%. Due to the slowest growth in the labor force in 25 years, the pool of prospective employees will continue to be small.[8] This scarcity of workers is also expected to boost telework: employers will offer more work options such as flex-time, "work at home days," job-sharing and similar perks in order to attract and retain talented workers.

Telecommuting can also be understood as providing access to additional labor pools, including the disabled and the senior population. In this sense, new communication and information technologies can level the playing field for employees. Christopher Newton, [9] President & CEO of Work/Life Benefits,

claims that flexible work arrangements such as telecommuting show a company's commitment to work/life issues, and therefore increase employee loyalty.

Telecommuting will also be driven by employers' interest in reducing overhead costs. Next to salaries, office space is often an organization's largest expense.[10] The rising cost of real estate has led to many innovative space-saving practices that work in conjunction with telecommuting, such as hoteling where telecommuting employees call in and "reserve" an office when they need to come into the office, satellite offices and teleworking centers. Estimates vary, but one study claims that $8,000 per worker can be saved through home offices; another article states that telework can cut corporate real estate costs by 25-90%. [11] While these alternatives to the central office do create substantial savings for the employers, they are also imbued with challenges. Issues such as the loss of workers' personal space and identity may grow with little understanding of the long-term implications. The need to create electronic environments that can effectively act as surrogates for the informal central office relationships desired by many organizational may not be attainable.

Purpose and Design of this Study

Amazing advances in communication and information technology mean that teleworkers are in the process of re-envisioning their home office space, their daily patterns of work, and their relationships with their organizations. This study was designed to observe and analyze the introduction of new technologies into home offices and then continue to observe the teleworkers as they learn to use the technologies. The research study was focused on learning how the introduction of new information and communication technologies creates changes (or not) in four areas: (1) the work practices of telecommuters; (2) productivity issues; (3) balancing work and family life; and (4) management and organizational aspects of telecommuting.

Participant Selection

An agency was utilized to find people who fit the criteria for the study: adults over 21, employed full-time, telecommuting from home offices several days per week minimum, with a range of experience telecommuting (one year to over 10 years), and from a variety of industries/institutions. Because the researchers were located in Southern California and the ICT access was donated by a California based organization, Pacific Bell (which also funded the study), the sample was chosen from California residents in or near major metropolitan areas (i.e., San Diego, Los Angeles, Sacramento, San Jose and San Francisco). Fifteen individuals have agreed to participate thus far and ten others are being sought.[12]

The first 10 participants have been through six months of the study and will be discussed in this report. Participants are employed in medium and large businesses as well as in start-up organizations. There are 7 men and 3 women. There are 3 participants each in the 20-29 and 30-39 age brackets, and 2 each in the age groups of 40-49 and 50-59. All the participants telecommuted at least two days a week, but had varying amounts of overall experience with telecommuting, ranging from about $1^1/_2$ years to as much as 19 years. The participants consist of a mix of single and married individuals; their households are with

and without children. Participants must not have had any prior experience in telecommuting from home with a high-speed connection. The participants are employed in the telecommunications, hi-tech, banking, and pharmaceutical industries, and the state government.

Methodology

The study has a somewhat unusual design. It is a combination of a field intervention — where the researchers institute the change — with what is commonly called a mini-ethnography.[13] Thus far, three in-depth interviews, at intervals of approximately one month each, have been conducted with each participant.

The first interview took place prior to the installation of the high-speed lines. Information was gathered regarding issues such as the maintenance of boundaries between work and home, issues of trust and management, communication and relationship with co-workers, patterns of use of technology, and changes in productivity due to telecommuting. The first interviews took place in the homes of the participants where the interviewers had an opportunity to observe the home offices of the participants. The locations of the home offices in relation to the rest of the living area, and the technological setup were noted. Following this initial interview, high speed DSL lines, along with a suite of services such as Call Waiting, Caller ID, Call Waiting ID, Call Forwarding, Priority Ringing, and the Message Center were installed in the homes of the participants at no cost to them.

The second and third interviews were focused on the participants' use of these technologies, and on investigations of the impact of these new technologies on the work practices, as well as on the productivity and work/life situations of the participants. The interviews were then transcribed and analyzed to highlight the common themes and motifs in the participants' experiences in telecommuting with DSL and related communication services.

Thematic Analysis

Common themes that emerged from the interviews with the various participants are summarized below.

The Disappearing Central Office

The conventional understanding of telecommuting rests on an implicit opposition between working in the home office or in the central office. Working at home used to be seen as a personal choice made by the individual telecommuter. This is often not an accurate definition of the telework circumstances in contemporary organizations. Transformations of organizational structures, and of the economy in general have resulted in a context where telecommuting is often not a choice but a necessary work arrangement. Five out of the ten participants in this study worked from home because they worked for organizations that did not have a central office location. Sometimes, a pre-existing central office had been phased out in order to cut back on real estate costs. Other times, the employer's investment in equipment (a PC, modem, printer, etc.)

for the telecommuter's home office was part of an agreement to give up a desk in the central office in order to avoid duplicating costs. In cases where there was a central office, constraints of space made it infeasible to have an individual desk at the office. This was the case of the participant who worked for a start-up company that could not yet afford the high rent of a big office, a common enough scenario in the current climate of entrepreneurial companies. Such work arrangements are not peculiar to the private sector either. One of the other participants, an employee of the state government, also worked at home because the office was a small building that had no room for him. In his case, the employer had actually initiated the discussion about telecommuting as part of the initial job offer. Finally, another participant's telecommuting was determined by the fact that his employer, a global organization with a national headquarters located on the East Coast, had no regional office location.

The Changing Geography of Work

The globalization of the economy, through the 1990s, has profoundly transformed organizational structures in diverse arenas of work. The prominent changes generated by globalization include the increasing outsourcing of work to overseas centers, and the concomitant growth and geographical expansion of firms, sometimes on a global scale. This geographical expansion, in synergy with the emergence of advanced tools of telecommunications, is recasting conventional relationships between co-workers, work teams, employees and their managers. Also, the continuing vertical and horizontal integration in diverse industries (manufacturing, banking, telecommunications, entertainment, etc.) has resulted in organizations whose circumstances (e.g., large size, work teams with dispersed locations, global distribution systems) do not lend themselves to face-to-face meetings.

Remote working relationships are common. In one case, the participant lives and works in his home in Northern California, but reports to his manager in North Carolina and manages his administrator who is located in Kansas. The experiences of other participants who live in California but report to remote managers on the East coast and the Midwest, and routinely work with teams dispersed all across the country, further stretch the meaning of telecommuting for us.

The software industry offers particularly striking examples of the new phenomenon of telecommuting across the globe. Many firms in the United States, for example, employ whole teams of software programmers who are based in India and who work along with teams based in the United States. These virtual teams, which often telecommute, using one participant as an example, from Bombay to the Silicon Valley, creatively harvest the time zone difference in order to increase, if not double their productivity. The 12-hour difference means that the Indian programmers get to work when the Americans are ending their workday, and vice versa. This kind of telecommuting also creates substantial savings for the U.S. firms due to the lower salaries of employees located in India and avoiding the expenses that would result from relocating these employees to the United States.

Balancing Work and Family

According to Levy, Flynn & Kellogg[14] (1999), balancing professional and personal lives is the mantra of the new millennium. They claim that while the emphasis on family is not new, its importance in shaping

decisions is more overt and openly discussed by professionals. They argue that the typical strategy for employee retention is higher salary and benefits, yet firms today must offer time and flexibility in order to honor employees' commitment to their family and children. Kathy Hazzard, manager of work/family programs at John Hancock, who has introduced many Alternative Work Strategies (AWS) such as telecommuting, compressed workweeks and flextime, claims that AWS are a tremendous morale booster and also a way to increase productivity.[15]

Work/life issues were of substantial importance to participants in the study. One female participant saw telecommuting as helping "with the struggle people feel between work and family pressures." Another male participant, a father of three children, described his being home when the children came back from school as being "the most significant impact" of his telecommuting. He readily admitted to taking time off during the day for non-work related tasks such as taking the kids to school, to the doctor's office, and running other necessary errands. He refused to call such tasks "distractions" from his work, arguing instead, "No, it's part of the work. I wouldn't call it a distraction. I think part of work is being available to your family when they need you. I don't see that as a distraction — I see that as something that should be honored." Since he was confident that he was making up for lost time by working beyond office hours, he felt that he could take time off during the workday when he was needed. For this participant who lived in a small rural city, traffic and commuting were non-issues: "it's the flexibility that's great," and that was the primary reason for his telecommuting.

Yet another participant, with a young daughter, was clear that his work schedule and his hours "are dictated by the fact that I have a daughter." His telecommuting consisted of leaving work early everyday, and working from home between 8 p.m. and 1l p.m. "I started telecommuting because I have to be at home in time for dinner . . ." He also worked from home on Mondays in order to help his daughter with her week's load of homework. Further, he added, "Around dinnertime it's nice to eat and see N**** (his daughter's name) — she appreciates that. And so there's all those issues that make long hours more — not enjoyable — but acceptable." For this participant, "the primary benefit" of telecommuting was "keeping a happier fiancée," and factors such as traffic and the commuting were of secondary importance.

It is important to note that both the above-mentioned male participants chose telecommuting despite their belief that, in the final analysis, telecommuting cost them rather than saved them money. The experiences of these telecommuters seem to be in accordance with Sue Shellenbarger's[16] (1999) claim that in the 21st century, the value workers place on time vs. money will continue to shift in favor of time. Or, as another participant put it, "the real reason I do what I do is so that I have flexibility with my kids."

Large scale demographic changes in American society, such as the aging of the baby-boomers[17] and the increasing entry of women into the workplace[18] will also mean that employers will have to acknowledge dependent care issues raised by workers from dual-income households. For example, in a recent survey of HR executives, 29% said that elder care would become the number one issue of the workplace and that telecommuting will be the predominant workplace trend of the next millennium.[19]

Workstyles

All the participants in the study enjoyed telecommuting and the flexibility it allowed them. But they were quick to add that "it is not right for all people." One participant, an experienced telecommuter, stressed that successful telecommuting had to do less with the *work ethic* of the employee and more with the *work style* of the employee. For example, an employee who is not self-motivated or who needs a social environment would not be as effective in a job designed to involve telework.

The participants described themselves as disciplined and self-directed. One male participant saw telecommuting as complementing his personal workstyle: "I am very self-motivated and I tend to be very focused . . . and I find that it's easier to stay on task working in a home office." The participants were also conscious about using their telecommuting time to do tasks that "require concentration, focus — such as writing reports, reviewing reports." Going to the office, in contrast, was reserved for clerical tasks like copying, where they could take advantage of the office infrastructure. In dividing their tasks between the home office and the central office, they reported saving certain types of tasks for the home office. Thus there was a clear *self-organizing* principle at work about the structuring of tasks, and a consensus about the kind of workstyles that were most conducive to telecommuting.

The participants all prided themselves on their independence and their ability to work unsupervised. All the participants also reported that they felt trusted by their supervisors. Many did have stories about past supervisors who did not believe that telecommuters working from home could be productive. They agreed that successful telecommuting depends in part on having enlightened managers who are comfortable with remote employees and can provide their employees with the trust and support necessary to work effectively at the home office.

Technology Issues

Most participants in the study (except one) were comfortable with technology and actively described themselves as such. It was evident from the interviews that these telecommuters are actively making choices between various email programs, online storage options, hardware choices such as fax machines, scanners, high-speed lines, hand-held devices, etc. Their pride in their technological savvy crossed gender boundaries; both male and female participants claimed to be actively involved in the setting up of their DSL connections and discussed in detail, the benefits and problems associated with the technology. Almost to a person, they would actively seek technological solutions to solve their problems of connectivity and access. They all had technological war stories — failures and successes in their efforts to gain maximum mobility for their data and themselves. One participant offered a myriad of anecdotes about her enormous efforts to synchronize the data in her computers, hand-held devices and her email programs. Describing themselves alternatively as "I'm pretty gadget-oriented" or "I'm a gadget kind of guy," or "I really like to be exposed to new technologies," the participants displayed a vivid enthusiasm for the latest and most sophisticated technological appliances.

The participants also mentioned to the interviewers some other new technologies (in addition to DSL) with which they were experimenting. One participant talked with interest about his new credit card that had a memory chip and was specifically designed for shopping on the Internet. Another participant described

his long search for a cell phone with a particular combination of features. They all were curious about new technologies and were eager to investigate new applications that would facilitate their telecommuting. One female telecommuter was also participating in the testing of a demo version of a new program that she had downloaded from the Internet.

This enthusiasm for new technology, however, can potentially lead to the "flavor of the month" problem. As one participant described it, given that new tools and technologies enter the market every day, it becomes a challenge for employers as well as for employees to know which technologies to adopt and to invest in. Issues of compatibility and longevity are key among many other criteria that need to be considered before making a decision.

The participants' wish list of tools included brand new technologies such as Desktop Videoconferencing, NetMeeting, Voice over IP, PC Anywhere, Internet-based VPNs, [20] etc. Many participants also expressed a wish for greater support from their employers in terms of regular upgrades of equipment, and tech support, that office-based employees might more readily receive. There seems to be a need to evolve formal policies and mechanisms that will address the question of regular maintenance schedules and a strategy for upgrading the technology in the home office of telecommuters.

Fostering Personal Relationships through Technology

Some theorists (e.g., Sias & Cahill 1998)[21] who have examined the relationships between virtual co-workers have expressed concern that telecommuting could negatively impact human relationships. They also suggest, however, that communication technology might serve as a substitute for physical co-location. The participants in this study had diverse reactions to the possibility of social isolation due to telecommuting. Some conceded that it was a problem and claimed they would never be able to work from home 100% of the time for that reason. They said they made an effort to keep in touch by calling co-workers on the phone or by making a special effort to socialize with coworkers during their visits to the office.

France Belanger (1999), [22] in her mapping of communication links in two work groups comprised of telecommuters and non-telecommuters, concluded that there is limited impact from telecommuting on the communication structure of workgroups. This would indicate that telecommuters need not necessarily be left out of office networks, or suffer the decline of personal relationships with their virtual co-workers. Indeed, it does appear that virtual groups are able to go beyond business environment to build personal relationships if they decide to do it. As an example, one of the participants described a "virtual roast" she had organized for a member of her virtual workteam. The virtual roast was "attended" by other members of the team from their locations all across the country. This telecommuter also claimed that she had been able to make friends with people she had worked with, even though sometimes she hadn't actually met them face-to-face. Further, she claimed that her transition to telecommuting was not really difficult because she had already worked with remote teams for years while based in the central office.

Another participant described what she felt was a cultural shift. She believed that people in general, were becoming more comfortable with having long distance work relationships. Overall, it is simply becoming culturally more acceptable to deal with people at a distance because it is so normative.

Productivity Issues

Measuring productivity in the case of telecommuters is methodologically challenging (Belanger & Collins, 1998).[23] Many telecommuters are knowledge workers whose work cannot be meaningfully measured with older measures of productivity. The participants of this study were commonly engaged in tasks such as creating and reviewing reports, researching and analyzing data on the Internet, writing proposals, designing training programs, etc. They also spent a lot of their time discussing various project-related issues with their virtual teams through conference calls and email messages. It is hard to quantify productivity in such cases as no specific outcome metrics are established by the participants or their organizations.

The decision was made to ask the participants to evaluate their productivity in terms of their relative perception of improvement (or lack thereof) with respect to certain activities and tasks. In addition, during the second and third interviews, they were also asked to mark on a Likert scale the extent to which they felt the new addition of the high speed DSL lines had affected their productivity. The various components of the productivity measure were arrived at by considering the common tasks that the participants were engaged in on a daily basis. These tasks were:

- Establishing Communication
- Maintaining Communication
- Gathering Information
- Disseminating Information
- Decision-Making
- Efficiency

The Likert scale ran from 1 to 5, with the following values:

1 indicates that DSL hinders your productivity

2 indicates that DSL somewhat hinders your productivity

3 indicates that DSL neither helps nor hinders your productivity

4 indicates that DSL somewhat helps your productivity

5 indicates that DSL greatly helps your productivity

The following are the averages of scores for the effect of DSL technology on productivity during the performance of individual tasks and collaborative tasks. The scores from the third interview are higher in both instances, indicating that once the initial glitches of installation and co-ordination were resolved, overall effectiveness in accomplishing the specified tasks, or productivity, was higher after the introduction of the new communication technology.

The researchers understand that the small sample size and the self-report data limit the generalizability of these results but find them informative in the context of this study.

Effect of DSL on Individual Tasks During Interviews 2 & 3
(Results from Interview 2 are on the first line and Interview 3 on the second line)

Establishing Communication	Maintaining Communication	Gathering Info.	Disseminating Info.	Decision Making	Efficiency
3.9	3.6	4.7	4.2	3.6	4.6
4.0	3.8	4.9	4.5	4.0	4.8

Effect of DSL on Collaborative Tasks During Interviews 2 & 3
(Results from Interview 2 are on the first line and Interview 3 on the second line)

Establishing Communication	Maintaining Communication	Gathering Info.	Disseminating Info.	Decision Making	Efficiency
3.8	3.9	4.2	4.4	3.4	4.3
4.1	3.9	5	4.0	4.0	4.5

It is also important to note that during the initial interview, many of the participants reported being more productive while working from home. The single most commonly cited reason for the increase in productivity was the lack of interruptions in the home office. Being able to work through uninterrupted stretches of time seemed to be the biggest advantage of the home office, and one participant claimed that working at home had made him more productive by about 200%-300%. Another participant, when asked if he felt disconnected from his co-workers because of his working from home, replied that not only did he not feel disconnected, but that being connected had only decreased his productivity! In a similar vein, another participant reported that he does his "actual work" at home while he only goes to the office to meet with people and attend meetings.

There was also evidence that telecommuting also increases overall productivity through reduced absenteeism. One participant felt that minor illnesses that might have prevented her from going to work didn't stop her from walking into the home office and participating, if only at a less active level, in the day's work. She felt that her employer gained through her increased productivity because she was not taking time off. In fact, she had been maintaining a record of three years of perfect attendance while telecommuting!

Discussion about the higher levels of productivity at the home office also often brought up the issue of perceptions of co-workers at the central office. The participants referred to the misunderstandings about telecommuters — that they don't work hard enough, that they are not supervised enough and that they are not productive enough. They insisted that, on the other hand, telecommuting took a lot of focus and discipline, and was attractive to them because it allowed them flexibility without compromising their productivity.

Experiences with DSL

Every participant reported that he/she enjoyed the enhanced speeds that allowed him/her to download and upload email or large data files, surf the web, etc., and reported greater productivity as a result of telecommuting through the DSL. Responses included "I think there is a huge increase in my productivity, at least 75% more productive than the original dial-up time!" and "I think I should be a DSL commercial!" or "I'm real satisfied. Very satisfied."

More than a couple of participants pointed out that DSL's fee structure (a monthly flat rate) was advantageous to telecommuters because with dial-up connections, the user is charged for every log in, and it gets more expensive the longer one stays online. One participant actually found that his telephone bills had declined after his switch to DSL.

A couple of the participants did feel that DSL's usefulness to them was somewhat compromised by the fact that DSL was not yet universally available. While they were able to download large files, emails, etc. with great speed, they couldn't nevertheless *send* such files to others on their work teams because a majority of their co-workers could not yet work with high-speed connections. Therefore those that do have DSL are still bound-by the technological limitations of an analog dial-up connection and felt that DSL's use to them would increase exponentially with each additional member of their work team that acquired DSL. As Lynn Markus argues (1990, 196), [24] in the absence of a sizable number initial users, the benefits of an interactive medium are low. These benefits grow as the interactive medium achieves universal access, and usage increases.

Before the installation of DSL, when asked to name the one thing they would like to change about their telecommuting, most said they wished they could have faster access to their network, the Internet, etc. Some also wished for a bigger and better organized home office. After the installation of DSL, the response to the same question concerned the price of DSL; many felt that its expense was a deterrent whether they or their employer were paying for it. Yet, all but one participant (who had been unable to get high speeds because of the location of her home) also admitted that the gains in productivity were worth the price of the connection.

Many experienced problems during installation and later in trying to co-ordinate DSL with the particular communication software of their employers' networks. For example, one participant couldn't log into work with DSL until about four weeks after the initial installation. A number of participants expressed the wish that Pacific Bell would provide greater support in terms of coordinating DSL with some of the commonly used pre-existing network protocols. Many also found it very useful that DSL had two separate lines for voice and data and enjoyed being able to research the Internet while they were on the phone. This enhanced their productivity, by allowing them to, for example, bring the latest information on the subject into the conversation during a conference call.

As mentioned above, most of the participants in the study were comfortable with technology and well informed regarding DSL. While they appreciated the convenience of DSL's being always on, they were also aware of the drawbacks of such a connection. More than a couple expressed surprise that neither the

technicians who came to install DSL nor the literature they received from Pacific Bell mentioned the security issues. The participants expressed concerns regarding the safety of their harddrives, and the vulnerability to hacking by outsiders. One of the participants, who dealt with confidential client information, was also concerned about sending emails with confidential content through DSL. Some were in the process of installing secure firewalls while almost all had made the decision to install them. It was also suggested that Pacific Bell should perhaps provide the DSL technology along with a package of firewall protection software.

Those participants who on a regular basis divide their time between a central office and the home office claimed that they had changed the way they divided the tasks between these two locations. For example, earlier, the availability of the TI connection at work meant that they would save their big online research jobs for times when they were at the central office. But now, because of DSL (which one participant claimed he found was comparable to a TI connection), they were able to expand on the kind of tasks they could accomplish at the home office. As a second effect, the speed enhanced their ability to complete tasks much more quickly, thus reducing the time spent overall on the computer. One participant specifically noted that while he earlier spent about three hours on the Internet every morning, he now spends only about one hour. By his calculation, he increased his productivity by 66%!

Not all participants in the study experienced equal speeds through their DSL connection. DSL's performance is extremely sensitive to the distance between the consumer's house and the central office of the provider. At present, the number of central services offices is still very limited. For this reason, DSL is also available only in certain select cities in California. Once these technological limitations are overcome, DSL will probably be widely available and widely adopted. According to the Wall Street Telecommunications Association Survey (1999), while analog dial-up and ISDN dominated 1999, by 2001 they will be superseded by DSL and cable modem as the technologies of choice for remote access. The experiences of the participants in this study and their levels of satisfaction certainly support such a forecast.

Remote Access Services[25]

	THRU 1999	BY 2001
Analogue dial-up	66.7%	50%
ISDN	66.7%	22.5%
Direct Connection	54.8%	9.8%
Internet	46.3%	32.5%
Frame Relay	22.5%	17.5%
Cable	10.0%	40.0%
ADSL/HDSL	4.9%	42.5%
Other	0.0%	0.0%

The Future

The importance of new technologies and the desire for increased verisimilitude with the office environment creates an interesting opportunity for an increase in distributed offices through integrated and interactive technologies. The possibilities provided by the next few generations of new communication technologies may further enhance telework. In the not too distant future, researchers will develop immersive environments, where teleworkers will see and hear their remote colleagues in a much more realistic way. Users will benefit from better sound, and perhaps engage their other senses as well (e.g., touch) which might remove some of the isolation of being at home. This is probably none too soon because as traffic jams rise in cities like Los Angeles, so will the need for formal strategies for telework as well as casual telecommuting. Our ongoing analysis will attempt to increase our understanding of the personal and organizational issues involved as these discussions and inventions engage us all.

End Notes

[1] The term telecommuting was originally coined to refer to the use of communication and information technologies to replace transportation (Nilles, Carlson, Gry & Hanneman 1976). Some researchers use the terms telework and telecommuting interchangeably, while others distinguish between the two. For example, Nilles (1998) defines teleworking as "ANY form of substitution of information technologies for work-related travel" but telecommuting more specifically as "periodic work out of the principal office, one or more days per week either at home, a client's site, or in a telework center" (p. 1). In this report, the terms are used interchangeably.

[2] Charles Babcock, "Telecommuting: The Future is Now," *Computerworld*, Vol. 29, No. 11, March 13, 1995. Babcock also reports that the employees of the Los Angeles Water District have experienced a productivity gain of 20% due to telecommuting.

[3] "A Century of Progress – A Century of Change," *Report of the Employment Policy Foundation*, September 1999.

[4] Daniel Hrisak, "Millions Move to the Homeoffice," *Strategic Finance*, Montvale, December 1999, pp. 54-57.

[5] ITAC testimony to MD Senate, March 4, 2000, Appendix II.

[6] Carol Dannhauser, "Who's in the Home Office?," *American Demographics*, Ithaca, June 1999, pp. 50-56.

[7] Mary Slepicka, "Remote Workforces Gaining in Strength," *America's Network*, Duluth, December 1, 1999, p. 16.

[8] Bureau of Labor Statistics, quoted in Ibid., 16.

[9] Kelly Dunn, "Telecommuting is a Tool of Millennial Business," *Workforce*, Vol. 78, No.11, November 1999, p. 20.

[10] Andrea Saveri, "Mapping the Future of the Virtual Office," *Electronic Engineering Times*, No. 859, July 31, 1995, p. 120.

[11] ITAC testimony to MD Senate, March 4, 2000, Appendix II.

[12] Finding teleworkers willing to be observed in their homes has been a challenging task. In addition, quite a large number of participants who had signed for the study were disqualified because DSL lines could not be hooked up to their homes (usually the distance was too great).

[13] A mini-ethnography is a richly detailed, longitudinal description and investigation, but not a true ethnography where the researcher lives completely within one environment for a given length of time (usually at least a year).

[14] Elliot Levy, Patricia Flynn, Diane Kellogg, "Balancing Professional and Personal Lives: The Mantra for the Next Millennium," *CPA Journal*, New York, October 1999, pp. 70-73.

[15] Judy Greenwald, "Employers Warming Up to Flexible Schedules," *Business Insurance*, Vol. 32, No. 24, June 15, 1998, pp. 3-4.

[16] Sue Shellenbarger, "For Harried Workers in the 21st Century, Six Trends to Watch," *The Wall Street Journal*, December 29, 1999, p. B1.

[17] The Bureau of Labor Statistics is projecting that between 1996 and 2006, those in the 45 to 54 and 55 to 64 age groups will increase by 30%, while those in the 35 to 44 age bracket will remain 25% of the labor force.

[18] The Bureau of Labor Statistics also predicts that by 2006, 47% of all workers will be women.

[19] "Everybody's Going Mobile," *Workforce*, Costa Mesa, September 1999, p. 32.

[20] VPNs (Virtual Private Networks) extend an employee's desktop computer applications and telephone services to any location, thus guaranteeing complete mobility of data.

[21] P. Sias and D. Cahill, "From Coworkers to Friends: The Development of Peer Friendships in the Workplace," *Western Journal of Communication*, Vol. 62, 1998, p. 3.

[22] France Belanger, "Communication Patterns in Distributed Work Groups: A Network Analysis," *IEEE Transactions on Professional Communication*, New York, December 1999.

[23] F. Belanger and R.W. Collins, "Distributed Work Arrangements: A Research Framework," *The Information Society*, Vol. 14, 1998, pp. 137-152.

[24] Lynne Markus, "Toward a 'Critical Mass' Theory of Interactive Media," in Jane Fulk and Charles Steinfeld, *Organization and Communication Technology*, Sage Publications, 1990.

[25] Monica Simms, WSTA Market Data Survey Results, *Wall Street & Technology*, New York, December 1999, pp. 74-78.